LASSEN VOLCANIC NATIONAL PARK
GEOLOGIC RESOURCES MANAGEMENT ISSUES
SCOPING SUMMARY

Sid Covington
Geologic Resources Division
May 27, 2004

Executive Summary

A Geologic Resources Evaluation scoping meeting for Lassen Volcanic National Park as held in Ashland, Oregon, March 1, 2004. The scoping meeting participants identified the following geologic resources management issues.

1. A volcanic hazard plan needs to be developed in the event of another major eruption.

2. Health and safety issues are of great concern at the areas of greatest hydrothermal activity.

3. Wetlands in the park are undergoing changes due to the hydrothermal activity. These changes need to be identified and monitored.

Introduction

The National Park Service held a Geologic Resources Evaluation scoping meeting for Lassen Volcanic National Park (LAVO) in Ashland, Oregon, Monday afternoon, March 1, 2004. The purpose of the meeting was to discuss the status of geologic mapping in the park, the associated bibliography, and the geologic issues in the park. The products to be derived from the scoping meeting are: (1) Digitized geologic maps covering LAVO; (2) An updated and verified bibliography; (3) Scoping summary (this report); and (4) A Geologic Resources Evaluation Report which brings together all of these products.

Lassen Volcanic National Park was established first as Lassen Peak and Cinder Cone National Monument on March 6, 1907. On August 9, 1916, the monument was established as Lassen Volcanic National Park. Several boundary changes have occurred since then and wilderness was designated on October 19, 1972. The park covers over 106,372 acres of Lassen Peak and surrounding volcanic and hydrothermal features. Of this, 78,982 acres are wilderness.

LAVO is covered by seven topographic quadrangle maps: Bogard Buttes, Prospect Peak, West Prospect Peak, Manzanita Lake, Lassen Peak, Redding Peak, and Mount Harkness. Four other quads, Viola, Grays Peak, Mineral, and Red Cinder, lie outside the park but are among the quads of interest. Geologic maps include GQ-248, the Geology of the Manzanita Lake quadrangle (1:62,500); GQ-345, Geology of the Prospect Peak quadrangle (1:62,500); OFR-84-224 (1:62,500), and the Geologic Map of California Westwood (Susanville) Sheet (1:250,000). Map I-2723 (1:24,000) covers Lassen Peak, the Chaos Crags area, and Upper Hat Creek. Mike Clynne with the USGS is preparing a geologic map, scale 1:50,000, of the greater Lassen area. It is projected to be completed in 2005.

Physiography

Lassen Peak is the southernmost volcano in the Cascade Range. The Cascade Range extends north into southern British Columbia - Mt. Garibaldi is the northernmost volcano. The highest volcanoes in the range are Mount Rainier in Washington at 14,411 feet and Mount Shasta just north of Lassen at 14,161 feet. The USGS has identified 13 potentially active volcanoes in the Cascade Range of the U.S. Pacific

Northwest, 11 of which have erupted in the last 4,000 years and 7 in the past 200 years (Dzurisin, *et. al.*, 1999). Between these volcanic centers the range is an undulating north-south trending lava plateau with elevations averaging about 4,000 feet in the Shasta-Lassen area (Norris and Webb, 1976).

Geologic History and Stratigraphy

In the Lassen area the Cascade Range is a broad ridge of volcanic rocks mostly late Pliocene and younger. The rock are mostly pyroxene andesite flows, silicic flows, and silicic pyroclastics (Muffler, *et. al*., 1982). The basement rocks are probably Mesozoic granites and metamorphics of the Sierra Nevada and extending to the Klamath Mountains. These are likely "overlain by a thin sequence of Late Cretaceous marine sedimentary rocks" (Muffler, *et. al*., 1982).

The Pliocene Tuscan Formation is the first and oldest volcanic unit above the basement. The Tuscan is composed primarily of mudflows, ash, and breccias, forming a ramp-like transition between Lassen and the Sacramento Valley. Maximum thickness of the Tuscan in the Lassen area is about 1,500 feet (Norris and Webb, 1976). Above the Tuscan are thick, extensive andesite flows followed, after extensive erosion, by Late Pleistocene basaltic lavas. Some of these lava flows cover 50 square miles and may have a total volume of 2 cubic miles (Norris and Webb, 1976).

Lassen Peak is a composite cone and has been active from about 600,000 year ago to the present. The last eruption was from 1914 to 1918. Lassen volcano developed in three phases: (1) a cone-building period of mostly andesite flows and pyroclastics; (2) further cone-building from thick, siliceous andesite lava flows; and, (3) the eruption of lava of composition from dacite to rhyolite, forming domes and flows (Muffler, *et. al*., 1982). Phases 1 and 2 occurred mostly in the vicinity of present-day Sulphur Works. The dacite dome of Lassen Peak was emplaced about 11,000 years ago (Muffler, *et. al*., 1982; Crandell, 1972). There are many indications that there is still a molten silicic magma body under Lassen dome field.

The eruption of May 1915 produced a column of ash and gas about 30,000 feet high. On the northeast slope of Lassen Peak a pyroclastics flow consisting of hot ash, pumice, rock fragments and gas swept down the volcano devastating a 3-square mile area. This combined with melting snow to form a fluid lahar that flowed almost 10 miles down Lost Creek. Other flows and lahars moved down all the flanks of Lassen (Clynne, et. al., 1999).

Lassen Geothermal System

In terms of surface expression, the Lassen geothermal system is by far the most prominent in the Cascades. It is a vapor-dominated system characterized by high-altitude (1800-2500 m) superheated and drowned fumaroles and acid-sulfate, low chloride, low bicarbonate hot springs. At lower altitudes (<1570 m) the hot springs are neutral with high chloride content (Muffler, *et. al*, 1982). The area of major up-flow is at Bumpass Hell where some of the highest temperatures have been recorded (Janik, *et. al.*, 1983). The waters from the acid sulfate springs are a mixture of condensed stream from the vents and meteoric water.

Paragraph 2(a) of Section 115 of the Department of the Interior and Related Agencies Appropriations Act of October 30, 1986 (Public Law 99-591) directed the Secretary of the Interior to publish in the

Federal Register a proposed list of significant thermal features in National Park Service units. Twenty-two units were listed in the February 13, 1987 *Federal Register* (p.4700), including Lassen Volcanic National Park. Specific thermal features identified were: Bumpass Hell, Little Hot Springs Valley, Sulpher Works, Devils Kitchen, Boiling Springs Lake, Drakesbad Hot Springs, and Terminal Geyser. The objective of the is law was to protect park geothermal resources from impacts of outside activities such as drilling and development of geothermal fields. Monitoring and protection were identified as the key elements in managing geothermal resources. Because of the fragile nature of these resources, they must be protected from visitor impacts as well as from industrial development.

To implement the provisions of Section 115 of PL 99-591 an Interagency Agreement (IA) was established among the Bureau of Land Management (BLM), National Park Service, U.S. Geological Survey (GS), and the U.S. Forest Service (FS). The IA ensured that the NPS would be consulted prior to any leasing, drilling or other development in an area that may impact the park's thermal features. In most cases, the relationship between geothermal resources and ground water is not clearly understood. The park must always be aware of any proposed changes or developments outside the park that might affect the groundwater system.

Significant Geologic Resource Management Issues in Lassen Volcanic National Park

1. Volcanic Hazards

Lassen Volcanic National Park shares a common need with other parks with active volcanoes: the need for an emergency response plan in the event of a major eruption. This was a major topic of discussion in a workshop held in Redding, California, September 26-29, 2000. The Resource Management Plan for LAVO prepared in 1999 summarizes the geologic resources and identifies the need for a revised assessment of the volcanic hazards. Since the last eruptions of 1914 to 1918, there has been a significant increase in population and infrastructure in area surrounding the park. Even small- to moderate-sized eruptions, which have been the most common in the region, could produce ash falls, lava flows, pyroclastics flows, and lahars that could have devastating effects.

The areas of greatest potential hazard are those in the immediate vicinity and down slope of Lassen Peak, Chaos Crags, Sunflower Flat, Poison Buttes, Tumble Buttes and Central Plateau - the northwest side of the volcano. The time of the year of an eruption would be of great importance. In winter a heavy snowpack would melt washing out the main park roads, service roads and State Highways 44 and 36. In the summer the park entertains most of its average 350,000 visitors. There is a need for an evacuation plan to remove these visitors as quickly and as safely as possible when a volcanic event begins.

2. Geothermal Hazards

The hot springs and fumaroles of LAVO are one of the major attractions to visitors and potentially one of the most hazardous. Kathy Janek, geologist with the U.S. Geological Survey, has been involved in monitoring and research of the geothermal features of Lassen for many years, but is retiring soon. Most of the areas that need monitoring have been identified. There is a need for more long-term monitoring and a map of the geothermal areas with cross-sections. U.S. Geological Survey Miscellaneous Field Studies Map MF-1484 (Muffler, *et al.*, 1983) needs to be digitized.

Other issues are the road to the Sulphur Works is being impacted by increasing geothermal activity including the appearance of new mud pots. Some of the boardwalks across the area have been replaced for the health and safety of visitors. As these thermal features continue to change over time, there is an increasing need to closely monitor these changes since these are areas of high visitation.

3. Wetlands

Alterations to wetlands are occurring due to the hydrologic connection between the wetlands and the geothermal water. There needs to be more research and monitoring of water movement through fens and floating bogs. Some are drying up and dying. Also, there is an increasing need to restore some of these wetlands. Surface water movement is also affecting the water quality in the park. Drinking water in the park is surface water except for one well, and the water from it is not fit for public consumption. There is a need to integrate geology, vegetation, soils, geomorphology, and hydrology in a comprehensive study of impacts of the geothermal activity on park resources.

Scoping Meeting Participants

Tim Connors	Geologist	NPS, Geologic Resources Division
Sid Covington	Geologist	NPS, Geologic Resources Division
Anne Poole	Geologist	NPS, Geologic Resources Division
Pete Biggam	Soil Scientist	NPS, Natural Resources Information Div.
Chris Currens	Aquatic Biologist	USGS, Biological Resources Division
Marsha Davis	Geologist	NPS, Columbia Cascades Support Office
Louise Johnson	Chief, Natural Resources	Lassen Volcanic National Park
Daniel Sarr	Network Coordinator	NPS, Klamath Network
Bob Truitt	Data Manager	NPS, Klamath Network
Hanna Waterstat	Data Miner	NPS, Klamath Network
Gary Rosenlieb	Water Quality Program Lead	NPS, Water Resources Division

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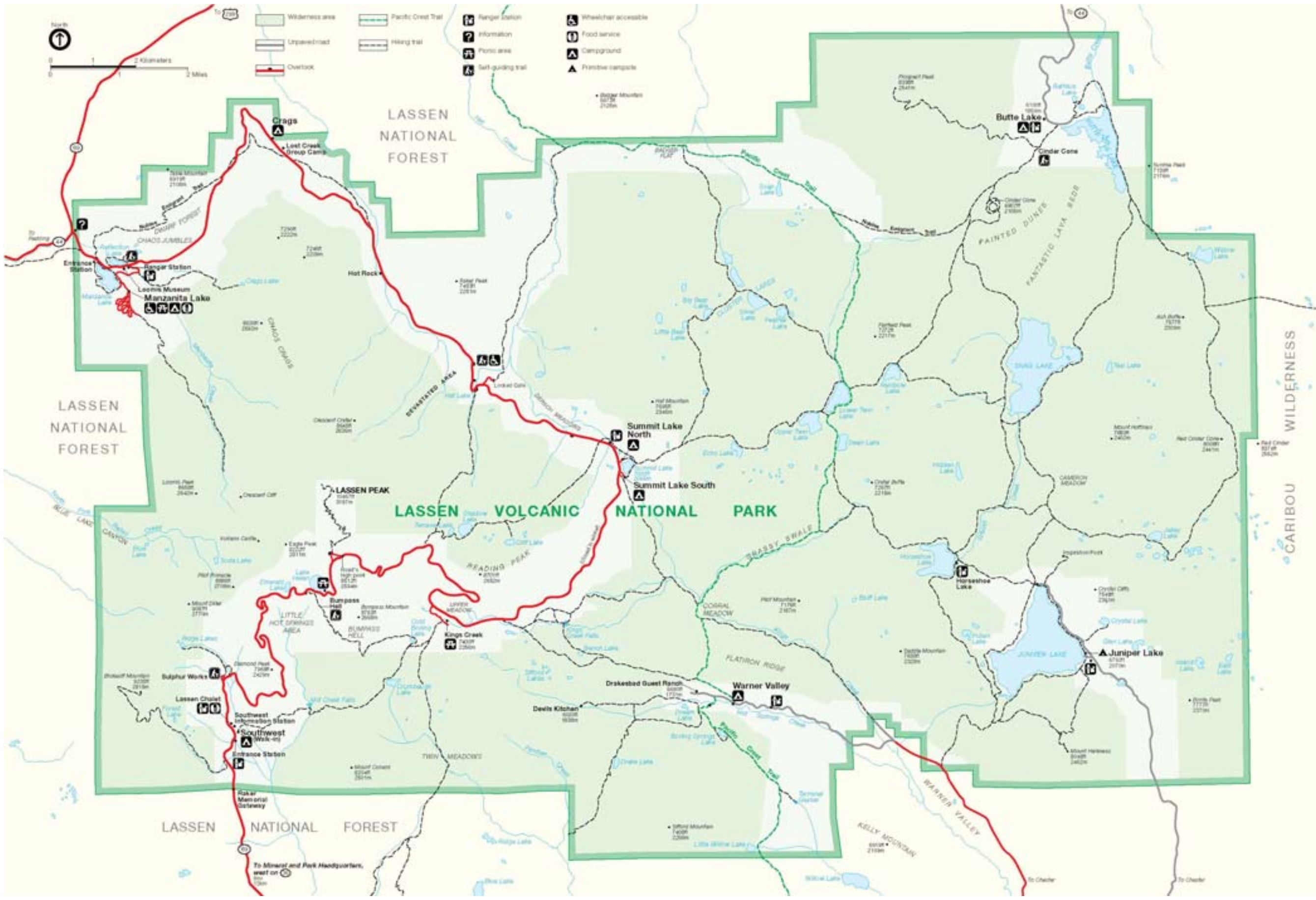
North
LASSEN NATIONAL FOREST
LASSEN NATIONAL FOREST
LASSEN NATIONAL FOREST
CARIBOU WILDERNESS
LASSEN VOLCANIC NATIONAL PARK
Crags
Lost Creek Group Camp
Entrance Station
Ranger Station
Loomis Museum
Manzanita Lake
Hot Rock
Summit Lake North
Summit Lake South
LASSEN PEAK
Bumpass Hell
Kings Creek
Sulphur Works
Lassen Chalet
Southwest Information Station
Southwest Walk-in
Entrance Station
Butte Lake
Cinder Cone
Horseshoe Lake
Juniper Lake
Drakesbad Guest Ranch
Warner Valley
Devils Kitchen
TWIN MEADOWS
CORRAL MEADOW
FLATIRON RIDGE
PAINTED DUNES
FANTASTIC LAVA BEDS
WARNER VALLEY
KELLY MOUNTAIN
Emigrant Trail
Nobles Emigrant Trail
To Mineral and Park Headquarters